DEVONIAN FOSSILS FROM SANDY'S CREEK, GIPPSLAND, VICTORIA

By Edmund D. Gill, B.A., B.D.,
Palaeontologist, National Museum of Victoria

Plates II and III, Fig. 1.

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Fossils from Sandy's Creek, a branch of the Mitchell River, in the Parish of Nungatta, Gippsland, Victoria, were handed to the writer for description by Mr. W. Baragwanath of the Victorian Mines Department. The specimens were collected by Mr. J. G. Easton, Field Geologist, in 1927, and Fig. 1 is taken from a map prepared by him. The fossils herein described came from the localities he marked G 22 - 26, and the types have been lodged in the Victorian Mines Department Museum.

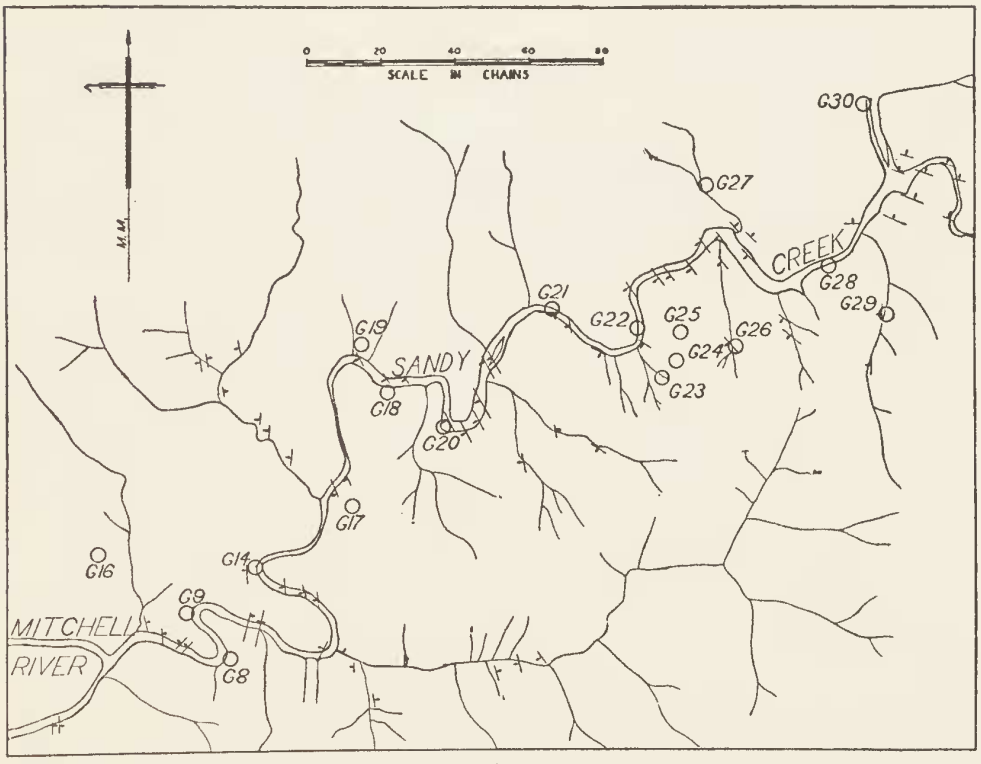

FIG. 1

Locality plan of part of Parish of Nungatta drawn from Mines Department map, originally prepared by J. G. Easton, Field Geologist.

Matrix and Facies

The fossils consist mostly of casts and moulds in a sandstone so fine-grained that it looks like a mudstone, but is nevertheless arenaceous; the fracture is shaley. The colour is light brown, but patches of grey suggest that originally the rock was of a grey colour and has turned light brown through oxidation of ferruginous matter. Some of the rock is not quite decalcified, certain specimens retaining part of the original calcic matter of the shells; a number of the latter were treated with hydrochloric acid to clear them for study. Thus, originally, the bedrock was a grey calcareous arenaceous shale.

Specimens 27,188 and 27,190[1] are of coarser sandstone, and are characterized by the presence of great numbers of crinoid stem joints. They represent a change in facies, no doubt towards shallower waters. A couple of pieces of rock are crowded with a branching polyzoan, and other small facies differences have been noted.

The fossils from Sandy's Creek are of Bohemian (Konieprusy) type facies, i.e., inner off-shore, or waters of moderate depth. The Lower Devonian beds of the Lilydale and Killara districts are of this facies (Gill, 1939, 1942, 1945a, 1945b, 1949a, 1949b, 1949c). As is often the case with this type of facies, calcareous beds are developed. Etheridge described corals (1899) and determined shelly fossils (1902) from Sandy's Creek.

The rocks from Sandy's Creek have been affected by shearing movements as is shown by the distortion of the fossils. Skeats (1929, pp. 108-111) has discussed the tectonics of the area.

Fauna

In the palaeontological collection studied, the following forms have been recognized:

PLANTAE

Frag. indet. of simple land plant of the *Hostimella* type.

ANTHOZOA

Casts of *"Lindstroemia"* type of solitary corals.

CRINOIDEA

Numerous stem joints and some pieces of stem.

POLYZOA

Acanthoclema flexuosa Chapman.

[1] Specimen numbers in this paper, unless stated otherwise, are registered numbers in the museum of the Victorian Mines Department.

BRACHIOPODA

Cariniferella alpha sp. nov.
C. beta sp. nov.
Conchidium polymitum sp. nov.
Eospirifer eastoni sp. nov.
Spirifer (*?Quadrifarius*) sp.
Protoleptostrophia affinalata sp. nov.
Hipparionyx major sp. nov.
Chonetes baragwanathi sp. nov.

LAMELLIBRANCHIATA

Tancrediopsis raricostae (Chapman).
Cosmogoniophora sp.
Pterineid fragment.

GASTEROPODA

Loxonema australis (Chapman).

PHYLLOCARIDA

? Ceratiocarid telson.

Distribution

Taking the specific determinations only, the distribution of the forms described is found to be as follows:

Faunule of Locality G 22.—*Acanthoclema flexuosa, Cariniferella alpha, C. beta, Eospirifer eastoni, Chonetes baragwanathi.*

Faunule of Locality G 23.—*Cariniferella alpha, C. beta Protoleptostrophia affinalata, Hipparionyx major, Chonetes baragwanathi, Loxonema australis.*

Faunule of Locality G 24.—*Cariniferella alpha, Conchidium* cf. *polymitum, Protoleptostrophia affinalata, Tancrediopsis raricostae.*

From locality G 25 *Hipparionyx major* is the only specific determination, and from locality G 26 there were none.

Age of Strata

Hill (1939, p. 220) stated that the beds at Sandy's Creek had previously been considered Upper Silurian, but in her opinion were Devonian; then, in a stratigraphical review in 1943 (table opposite p. 64), placed the Sandy's Creek beds on the boundary between Siegenian and Coblenzian, but indicating by arrows that

the age could be between basal Lower Devonian and basal Middle Devonian, as determined from the coral evidence.

In the present study, it is noted that the *Loxonema australis* from Sandy's Creek cannot be distinguished from the type specimen which came from the Lilydale limestone, nor *Tancrediopsis raricostae* from the type specimen collected from beds of Yeringian age at Killara. *Protoleptostrophia affinalata* cannot be specifically distinguished from specimens which occur in beds among the highest in the Lilydale sequence, viz., at Hull Rd., Mooroolbark. The *Eospirifer, Protoleptostrophia, Hipparionyx,* and *Chonetes* from Sandy's Creek are comparable with forms found in the Upper Yeringian shales and sandstones at Lilydale (*vide* Gill, 1945a), but are more advanced, and therefore probably slightly younger. Immediately above and slightly younger than the shales and sandstones at Lilydale is the Lilydale limestone, which is generally regarded as belonging to the upper end of the Lower Devonian, although Hill (1939, 1943) considers a Middle Devonian age possible. The Sandy's Creek beds containing the fossils described in this paper are probably comparable in age with the Lilydale limestone, but cannot be placed in the Middle Devonian because of the presence of the genera *Eospirifer* and *Hipparionyx,* which do not extend beyond the Lower Devonian. On present knowledge, therefore, the age of the Sandy's Creek beds referred to in this paper is considered to be the top of the Lower Devonian, i.e., Coblenzian.

A curious element in the fauna is *Cariniferella,* a genus of Upper Devonian age in North America and Europe. However, this genus has been erected comparatively recently, so that its range and relationships are not well known. It is herein recorded from Australia for the first time.

Systematic Descriptions

POLYZOA

Genus ACANTHOCLEMA Hall

Acanthoclema flexuosa Chapman

Acanthoclema flexuosa Chapman, Rec. Geol. Surv. Vic., Vol. IV, Pt. 2, 1920, p. 189. Pl. XXIV, Fig. 20; Pl. XXXII, Figs. 38-40.

A branching polyzoan from locality G 22 (specimens 27,207, 27,208 and 27,211) apparently belongs to Chapman's *Acanthoclema flexuosa,* described from the Gibbo River, N.E. Gippsland, and regarded as Yeringian in age. The holotype of this species is housed in the National Museum, and is Reg. No. 13,964.

BRACHIOPODA

Genus CARINIFERELLA Schuchert and Cooper

Cariniferella alpha sp. nov.

Pl. III, Figs. 1, 6, 7.

Type Material. *Holotype* consisting of the steinkern of a ventral valve, specimen 27,202 from locality G 22. *Paratype* consisting of the steinkern of a dorsal valve, specimen 27,219 from locality G 23. *Chonetes baragwanathi* sp. nov. occurs on the same face of the specimen.

Description of Holotype. Ventral valve sub-orbicular in outline, moderately convex. Hingeline straight, less than greatest width of shell; cardinal angles obtuse; rounded anterior border. Narrow low fold down midline. Length 2·1 cm., width 1·6 cm., the measurements being taken in one plane, i.e., not following the convexity of the shell surface. Interarea smooth, comparatively high (2·5 mm.), apsacline. Beak comparatively prominent, incurved.

Interior with deep delthyrial cavity; teeth strong. Well-defined dental plates, which in the holotype are continued as faint ridges which recurve round the anterior ends of the diductor scars. These ridges are not seen in all specimens. Diductor scars elongate, reaching a point 1 cm. from the umbo, i.e., nearly half way down the length of the valve; elevated adductor track, adjustor scars narrow, short, posterior to diductor impressions.

External ornament shown on margin of internal surface of valve, and is multicostellate, frequency of costellae being 25-30 per cm.

Description of Paratype. Dorsal valve of similar outline to ventral valve. Convex, but less so than ventral valve. Strongly developed carina or sinus down midline of shell; anterior commissure sulcate. Ornamentation multicostellate as shown round edge of steinkern; increase by bifurcation. Interarea smooth, anacline. Sockets deep, oblique; brachiophore plates widely divergent, high, merged with median callus ridge which fades into the carina down the midline. Cardinal process small, shaft narrow, serrated with almost vertical striae at the posterior end. The cardinalia are all close to the posterior margin of the shell.

Muscle field of dalmanellid type, ovate, divided mesially by the deep sulcus characteristic of the genus; almost surrounded laterally and posteriorly by ridges, which are crossed obliquely in two places on each side by faint furrows, i.e., ridges in the steinkern.

Comment. Specimen 27,213 from locality G 22 contains a partially decorticated dorsal valve of *C. alpha* which shows very clearly the punctate nature of the shell substance of this species; the nature of the median callus, brachiophores, and cardinal process can also be seen. The part of the external mould in view shows the presence of fine growth lines over the costellae, and two fine concentric rugosities. It shows also that there are intercalations among the costellae as well as bifurcations, although the latter are more common. The costellae are rounded in cross-section.

The genus *Cariniferella* is Upper Devonian in U.S.A. and Europe (Schuchert and Cooper 1932, Shimer and Shrock 1944), and has not been recorded from Australia before.

Cariniferella beta sp. nov.

Pl. III, Figs. 2-4, 9.

Type Material. Holotype consisting of the steinkern of a ventral valve, specimen 27,182 from locality G 22. *Paratype* consisting of the steinkern of a dorsal valve, specimen 27,210 from locality G 22. *Conchidium polymitum* occurs on the same face of the specimen.

Description of Holotype. General structure of shell similar to that of *C. alpha,* but—

(1) The proportions are noticeably different. The shell is transversely sub-elliptical, and measures 2·4 cm. wide and 1·4 cm. long, i.e., the proportions are the reverse of those found in *C. alpha. C. beta* is much wider than long, while *C. alpha* is much longer than wide.

(2) The muscle field assumes approximately the proportions of the general outline, and is more squat than in *C. alpha.* The muscle field is 8·5 mm. long down the midline, and 7 mm. wide across the middle of the field.

Description of Paratype. The general structure of the shell is very much like that in *C. alpha,* and the better development of the muscle field is probably just an expression of greater maturity in the paratype specimen of *C. beta.* However, the chief differences noted between the two species are:

(1) The differences in proportion noted in the ventral valve apply to the dorsal valve as well. The paratype dorsal valve is 2·2 cm. wide and 1·3 cm. long.

(2) The muscle field is more squat than in the compared species, measuring 6·5 mm. long (i.e., from the umbo) and 8·5 mm. wide.

(3) The median sulcus or carina is not so well developed as in *C. alpha*. This sulcus is deep in *C. alpha* in both young shells (e.g., on specimen 27,220) and old shells, but at no time in the life history is the sulcus deep in *C. beta*.

Comment. Study of the growth lines on these shells shows that the sub-orbicular outline of *C. alpha* and the sub-elliptical outline of *C. beta* are approximately the same throughout life, i.e., their outlines do not change in proportions during growth. The two species are readily distinguished by their outlines.

Genus CONCHIDIUM Hisinger, 1799

Conchidium polymitum sp. nov.

Pl. II, Fig. 7; Pl. II, Figs. 9, 12, 18.

Type Material. Holotype consisting of steinkern of ventral valve, specimen 27,181 from locality G 22.

Etymology. The trivial name is derived from the Greek word *polymitos* (= with many threads). It refers to the multistriate ornamentation of this species.

Description of Holotype. Ventral valve very convex. Umbo high but not overhanging that of the dorsal valve. Shell thick; ornamentation of very numerous striae. Part of the original calcic material of the shell is preserved and shows the shell substance to be impunctate.

Interior with strong spondylium supported by a median septum about 1 cm. long. Measured posteriorly the spondylium is 6·5 mm. wide and 8 mm. high on the outside measurement, and 5·5 mm. wide and 6·5 mm. high on the inside measurement. The septum is high; it is thick where it joins the spondylium on the floor of the shell, then gradually thins both dorsally and anteriorly. A fine furrow continues the line of the septum for some distance; this is flanked on one side by a fine ridge which may be the result of crushing. As with the other fossils of this fauna, the holotype has suffered shearing. Genital markings are very distinct in the umbonal area of the valve.

Comment. In the collection from Sandy's Creek there are two dorsal valves of *Conchidium* (specimens 27,205 and 27,228), but these vary from one another, and at present there is no way of telling whether one or neither of these is the dorsal valve of *C. polymitum*. However, in both specimens the septal plates are long (half the length of the valve or more) and slightly divergent.

From the series of specimens present, it is clear that *C. polymitum* was biconvex, subtriangular, and rectimarginate; also the

surface costellae had a frequency of about 24 per cm. However, the ornamentation was finer at the umbo (specimen 27,195B). The beaks of some specimens are more recurved than others, but none are as rostrate as the genotype.

The nearest relatives of *C. polymitum* are found in beds of similar facies and age at Killara and Lilydale, but these forms have not yet been described. Somewhat similar shells have been described by Shirley (1938, pp. 474-475) from the Baton River Beds of Lower Devonian age in New Zealand, but the coarse ornamentation on Shirley's specimens is very different from that on *C. polymitum*.

Genus EOSPIRIFER Schuchert, 1913

Eospirifer eastoni sp. nov.

Pl. III, Figs. 20, 21, 23.

Type Material. Holotype consisting of the steinkern of a dorsal valve on specimen 27,180, and part of the external mould of the same shell on specimen 27,183, the two specimens being counterparts. Both are from locality G 22, and *Chonetes baragwanathi* occurs on the same slab.

Description of Holotype. Valve convex, non-plicate, large, being about 5·5 cm. wide and the same long, the measurements being taken in one plane, i.e., not following the contours of the shell. When the profiles are followed, the width is about 7·8 cm. and the length 8·8 cm. Precise measurements are not possible as there is slight lateral crushing and all the margin is not preserved. Fold down middle of shell rises anterior to the umbo, rapidly gaining height and then gradually widening towards the anterior margin. The fold is about 7 mm. wide in the middle of the shell, and about 1 cm. wide at the anterior end. The fold varies from 4 to 5 mm. high. A narrow and low median fold is superimposed on the main fold from where the latter commences to a point more than half way down the midline of the shell.

Palintrope well developed; interarea covered with fine transverse striae, and 2·3 to 3 mm. high. Shell considerably thickened about the umbo; beak small. Hingeplate strong, divided, with laterally elongate sockets in which to accommodate the teeth of the ventral valve. Hingeplate supported by strong crural bases, which are in the form of lamellae, slightly divergent, which reach a point about 8 mm. from the umbo. They lose height rapidly just in front of the anterior edge of the hingeplate, but rise a little and thicken before terminating. Between them is a broad low ridge (a depression in the steinkern).

Ornamentation of fine costellae shows faintly on the steinkern, being clearer at the anterior end of the shell. The external mould shows the ornamentation to consist of fine costellae or striae, rounded in cross-section, which average 34 per cm., variation occurring according to the frequency of new intercalations. As increase is by intercalation, the new fine ribs alongside the full-sized ones sometimes give an appearance of pairing or alternation of costellar size. Fine growth lines cross the costellae, with a frequency of the order of 17 per mm. In places there are stronger growth lines, generally discontinuous. In the piece of external mould preserved, there are also a couple of growth lines so strong and continuous as to form fine ridges which interrupt the ornament.

Comment. The thickened shell and heavy growth lines are considered to be evidence of phylogerontism. *Eospirifer* ranges from Middle Silurian to Lower Devonian. Other specimens of *Eospirifer* have been figured from Victorian strata (Gill, 1942), and other undescribed forms are held, but the new species is nearest that figured in the 1942 paper on Plate VI, Fig. 8 (Nat. Mus. Vic., reg. no. 14,105), from Lilydale. Both have the superimposed secondary folds which are well known also in *E. secans* (Barrande) which Shirley (1938) has figured from the Baton River Beds of New Zealand. However, although alike, they differ in the structure of the cardinalia, and the Sandy's Creek fossil is notably bigger. The two forms are closely related but not identical.

The species is named after Mr. J. G. Easton, who collected the Sandy's Creek fossils.

Genus SPIRIFER Sowerby, 1814

Subgenus *Quadrifarius* Fuchs, 1923

Spirifer (*?Quadrifarius*) sp.

From locality G 22 on Sandy's Creek, there is preserved the steinkern of a spiriferid (specimen 27,195B). It is a ventral valve with a well-defined non-costate sinus on each side of which there are ten costae. The shell is broader than long, and the beak well-defined. The valve is 2·5 cm. wide and 1·8 cm. long, these measurements being taken in one plane. Dental plates 7-8 mm. long and about half a millimetre wide, which follow down the outer flanks of the costae on each side of the central sinus of the shell. There is also a weakly-defined median septum about 12 mm. long, i.e., about two-thirds the length of the shell. No external mould was among the fossils received, and thus it was impossible

to determine the nature of the external ornament, which is important in this case. For this reason the fossil is referred with some reserve to *Quadrifarius,* but it has the long ventral median septum and dental plates found in that subgenus (Fuchs 1923, Asselbergh 1930, 1931, Dahmer 1942). The long median septum and dental plates are seen also in smaller ventral steinkerns on specimens 27,216 (from G 23) and 27,232 (from G 25).

Genus PROTOLEPTOSTROPHIA Caster, 1939

Protoleptostrophia affinalata sp. nov.

Pl. II, Fig. 6; Pl. III, Figs. 19, 22.

Type Material. Holotype consisting of the steinkern of a ventral valve, specimen 27,214. There are more than twenty shells of this species on the slab or rock containing the holotype, along with a dorsal valve of *Chonetes baragwanathi.* The holotype is marked with an "A" on the specimen. *Paratype* consisting of a steinkern of a dorsal valve on the same slab of rock as the holotype. The paratype is marked with a "B" on the specimen.

Description of Holotype. Ventral valve slightly convex, subsemicircular. Width as preserved 2·7 cm., probably 3 cm. when complete; length 2 cm. Shell has a few weakly-developed, discontinuous, concentric wrinkles. Hingeline greatest width of shell; cardinal angles alate. Interarea makes an angle of the order of 120° (measured with the eye only) with the plane of the shell. Teeth file occupies only about one-quarter of the height of the area, which is about 1 mm. Teeth vertical (i.e., at right angles to the hingeline), fine, and even, there being approximately 3 per mm.

Muscle field well defined by dental ridges which form an angle of about 40° (though in other specimens it ranges as high as 70°); about 12 mm. long, i.e., more than half the length of the shell. At the posterior end, the muscle field is very narrow, then spreads out anteriorly. At the fine posterior apices of the diductor scars, on each side of the median septum, there are pronounced knobs on the steinkern which represent cavities on the original shell. The muscle scars are striate, and on each side of the median septum the diductors are divided by ridges into three more or less equal areas. The median septum is broad and low. At the posterior end the septum is characterized by a superimposed median furrow (ridge in steinkern) about 3 mm. long.

Outside the muscle field, the whole inner surface of the shell is very finely and closely papillose, the papillae extending right to

the margin of the shell, so that the costellae of the external surface are not shown as is so often the case with strophomenids. The papillae cover much of the median septum between the muscle scars, and also run up the ridges effecting the tripartite division of the muscle areas on each side of the septum.

Description of Paratype. Dorsal valve more or less flat with holocrenulate hingeline; there is no interarea apart from the teeth file. Small quadrifid sessile cardinal process, scarcely if at all extending beyond the hingeline. The two central prongs of the process are elongate, being about 1·5 mm. long and 0·5 mm. wide. They are but slightly splayed apart. On each side of these larger prongs, almost at the hingeline, are much smaller ones. Crural bases obselete. Adductor scars small, posteriorly situated, the rims forming a pair of inverted U-shapes. Stronger papillae occur on each side of these scars than occur on the rest of the inner surface of the valve.

Comment. Other specimens on the same slab as the types indicate that the ornamentation of the external surface is costellate. The new species varies in proportions, but it is difficult to make satisfactory measurements owing to the crushing which the matrix has suffered. There are variations also in the length and width of the ventral median septum, although the specimens available hint that there may be two distinct varieties. More material is needed to determine this with certainty. The extension of the papillae to the edge of the inner surface of the ventral valve indicates that secondary deposition occurred over the whole of the interior of the valve, a condition which contrasts with that usually observed in strophomenids.

The large muscle field with its strongly developed ridges in the ventral valve is a mark of an advanced form in a genetic sequence, and may be compared with similar structures in *Hipparionyx*. The early protoleptostrophids show no division of the ventral muscle into bundles (e.g., *P. plateia* from Tasmania—Gill, 1948). Then follow forms in which a tripartite division is present, as in the new species described above. Finally, there is the group covered by the genus *Leptostrophia* in which a further division has taken place, giving six muscle bundles. Since *Proleptostrophia* is found in both Lower and Middle Devonian, while *Leptostrophia,* although a specialized form, existed only in the Lower Devonian, it is to be inferred that *Leptostrophia* was an offshoot from the main line of development. It appears to have ended in a cul-de-sac, while the less specialized *Proleptostrophia* gave rise to other forms.

Generic Position. This form is tentatively referred to *Proleptostrophia* (Caster, 1939), which has been defined in brief by Cooper (in Shimer and Shrock, 1944, p. 341) as "Smaller than *Leptostrophia* with nearly flat dorsal valve; ventral musculature like *Leptostrophia*; dorsal interior with small bilobed cardinal process and small posteriorly located adductor field." *P. affinalata* agrees with this diagnosis except for the two minute knobs outside the main prongs of the cardinal process, making it into a quadrifid one. However, *P. affinalata* closely approaches *Leptostrophia,* and without a bigger range of specimens one cannot be sure that fully mature forms are present.

The holotype of the new species possesses a few weakly-developed discontinuous wrinkles, but these are not the "strong concentric wrinkles as in *Leptaena*" to which Caster refers as distinguishing *Rhytistrophia.* There seems to be a gradation from shells without wrinkles into the strongly wrinkled ones accommodated in *Rhytistrophia.*

Affinities. The trivial name of the new species is intended to indicate its affinity with *P. alata* (Chapman, 1903) from north of Lilydale (for precise locality see Gill, 1940), which is Upper Yeringian. The two species have a similar crenulation, standing in contrast with another group of protoleptostrophids which has the whole height of the ventral interarea occupied by the teeth file as in the genotype of *Leptostrophia.* The two species also have similar alate cardinal angles, and both possess a quadrilobate cardinal process. However, *P. affinalata* differs from *P. alata* chiefly in the following points:

(1) The ventral muscle field of the new species is much more developed than in the compared species. *P. affinalata* has a large excavated muscle field with a long median septum, strong dental ridges, and ridges dividing the diductor muscles into bundles. *P. alata* has a smaller, unexcavated muscle field with but moderate dental ridges, and the diductor muscles not divided into bundles by ridges.

(2) The interior of the ventral valve is much more strongly papillose in *P. affinalata* than in *P. alata,* and the latter is characterized by a row of larger papillae ranged along the dental ridges. The second feature is seen in a number of protoleptostrophids including *P. plateia,* and undescribed forms from Killara and Heathcote districts in Victoria. No such row of papillae occurs in *P. affinalata.*

Distribution. Brachiopods not specifically separable from *P. affinalata* have been collected from Hull Road, Mooroolbark.

These specimens have the same long and well-defined ventral muscle field, although not quite so prominent as in *P. affinalata*. The ridges dividing the diductors into three bundles are present, but again not quite so prominently. Also, the whole interior of the valve is covered with fine papillae, but this secondary deposition is not sufficiently thick to completely mask the external ornament as is the case with the Sandy's Creek fossils. In short, the same structures are present in the specimens from the two localities, but their development is less pronounced in the Mooroolbark form. One is presented with the problem as to whether these differences are genotypic or phenotypic, due to inherent constitution or merely to facies effects or differences in degree of maturity. An attempt was made to solve this by studying the young forms of *P. affinalata* preserved on the same slab as the holotype. It was noted that in specimens half the size of the holotype that the same strong papillosity is present and extends right to the edge of the shell. It is thus clear that the extent of the internal ornament is not affected by degree of maturity. The same applies to the general definition of the muscle field. However, the median septum and ridges dividing the ventral diductors into bundles are very indistinct in the young specimens; these therefore are features that vary with degree of maturity. As there are no major facies differences between the Sandy's Creek beds and the Mooroolbark ones in which the fossils under discussion were found, it may be inferred that the difference in degree of internal ornament is a genotypic and not a phenotypic one. The most developed of the specimens from Mooroolbark is not nearly as advanced as the well-developed specimens from Sandy's Creek.

Variant Form. Specimen 27,229A from locality G 24 preserves a ventral valve of *Protoleptostrophia* which varies from *P. affinalata* in that the teeth occupy the whole of the ventral interarea, and not just the anterior part of it. This is the only specimen noted in the collection with this variation.

Genus HIPPARIONYX Vanuxem, 1842

Hipparionyx major sp. nov.

Pl. II, Figs. 1-3, 8.

Type Material. Holotype consisting of the steinkern of a ventral and a dorsal valve lying with hingelines together, flat open (specimens 27,177 and 27,179 glued together) and the external mould of same (specimens 27,178 and 27,201 glued together) from locality G 22. As the steinkern and external mould are impres-

sions of different parts of the same biological specimen, they are collectively regarded as the holotype. *Paratype* consisting of the steinkern of a dorsal valve (specimen 27,235) from locality G 25. It is to be noted that the paratype comes from a different locality from that of the holotype, but the two localities are close to one another both geographically and stratigraphically. A large part of a dorsal valve is also present in the material from G 22 (specimen 27,179).

Description of Holotype. Ventral valve outline subcircular. Valve flexed so as to be a little convex near the umbo and a little concave for most of the remainder of the shell. Hingeline shorter than greatest width. The broken margin precludes precise measurement, but the shell was 6·5-7 cm. long and 7·5-8 cm. wide. Ornamentation of costellae radially disposed except that those near the hingeline are bent back to meet it. On the umbonal half of the shell the ornament looks comparatively disperse, while in the marginal area it looks closely packed. On the umbonal half the costellae appear to alternate in size, while in the marginal half they appear to be of equal size. This general appearance is due, first of all, to the presence of primary costellae which alternate in the umbonal half of the shell with secondary costellae. The primary costellae can be traced right to the umbo, where the secondary costellae are so fine that they cannot be traced without doubt. The secondary costellae increase in size until they equal the primary ones. About a third of the way to the anterior margin, tertiary costellae are intercalated, and by half way down the shell they become a noticeable part of the ornament through increase in size.

Thus in the marginal half of the shell, primary, secondary and tertiary costellae, having reached equal size, impart a regular and fine appearance to the ornament. Towards the margin, further intercalations and some bifurcations cause the regularity of the ornament to be maintained. Concentric ornamentation is also present in the form of fine lines which in the centre were counted as 28 per cm., but on the sides of the shell are still finer, because the shell has to grow faster anteriorly than laterally in order to maintain its proportions. Yet a third type of ornamentation is present in the form of concentric rugae, or rather furrows. The most marked and continuous of these are where the more disperse ornament of the posterior end of the shell is replaced by the more regular ornament of the anterior end. The ornament of the dorsal valve is similar to that of the ventral valve. This description has been made from a plasticine impression of the external mould of the holotype.

Interarea 4·5 mm. high in the middle; forms a somewhat acute angle with the plane of the exterior shell surface. Teeth supported by strong dental plates which continue anteriorly into thick ridges which completely enclose the muscle field. The dental lamellae and ridges are not vertical, but rise from the floor of the shell inwards at an angle. Muscle field inverted heart-shape, 2·5 cm. long down the midline and with greatest width of 2·8 cm. Adductor impressions of oval outline, about 1 cm. long and 0·5 cm. wide, divided by a broad low median septum which becomes higher and sharper on the anterior side of the impressions. Adductor scars nearly smooth, and surrounded by diductor scars radially strongly furrowed, and with concentric fine lines and rugae. Anterior margin somewhat crenulate. The remainder of the interior of the ventral valve is marked with costellae (especially near the margin), with concentric ridges, and with very numerous fine papillae irregularly disposed. The papillae tend to be bluntly conical in shape, but a great number are irregular.

Interior of dorsal valve shows massive cardinalia. Strong blade-like septum 1·5 mm. high at the posterior end, but decreasing in height and width anteriorly. Septum reaches about 2·8 cm. from the hingeline. Large crural bases about 1·5 mm. wide, disposed more or less parallel with the hingeline.

Description of Paratype. The dorsal valve of the holotype, being *in situ,* is naturally partly hidden at the posterior end by the big umbo of the ventral valve. A paratype consisting of a steinkern of a dorsal valve is therefore presented in order to elucidate the umbonal structures. This steinkern shows a very large cardinal process with two large discrete prongs, each divided posteriorly into two small knobs or processes. The prongs are splayed apart (Pl. II, Fig. 2), are 3·5 mm. wide, and merged anteriorly into the median septum, which in this specimen is prominent for 2 cm. but continues less conspicuously to a point 3 cm. from the umbo. At the umbonal end, the septum is 1 mm. wide and 1·5 mm. high. The size of the cardinal process means it would project some distance into the umbonal cavity of the ventral valve, but the holotype steinkern shows that this was capacious. The crural bases are strong, 2 mm. wide, and stand parallel to the hingeline. The cardinal and brachial processes are fused into one massive plate. Palintrope obsolete.

Comment. Points of ecological interest are:

(1) The presence of the two valves together in the holotype is evidence of comparatively quiet waters, an inference already made from the composition of the fauna as a whole.

(2) The difference in ornamentation on the different parts of the mature shell means that the young forms have quite a different appearance from the older ones.

(3) Specimens 27,231 and 27,216 show corals growing on *Hipparionyx* shells.

(4) *Hipparionyx major* is the biggest Lower Devonian brachiopod known in Australasia, and perhaps in the world.

(5) The costellae of the outer surface show clearly on the margin of the inner surface of the shell. Inside that margin is the papillate area. There are no papillae on the costellate margin of the inner surface. So apparently the shell was thickened by secondary deposition on the inside of the shell, and the papillae were part of the secondary growth.

Points of evolutionary and palaeogeographic interest are:

(1) *Hipparionyx minor* and *H. proximus* form an evolutionary sequence in the Lower Devonian rocks of North America, the former being characteristic of the Chapman sandstone and the latter of the succeeding Oriskany sandstone. *H. proximus* is essentially a more developed *H. minor*. Such a sequence appears to be present in the Lower Devonian rocks of Victoria. Brachiopods from the Lilydale district have been referred to *H. minor* (Gill, 1942), and *H. major* sp. nov. is essentially a more developed *H. minor,* hence the trivial name. Although *H. major* is distinct from *H. proximus,* it is nevertheless comparable with it in degree of development and in size. In view of this evolutionary trend, it is likely that the beds containing *H. major* are a little younger than those containing *H. minor*. A similar conclusion is reached from the study of *Chonetes baragwanathi* sp. nov. and *Protoleptostrophia affinalata* sp. nov.

(2) The massive character of the cardinalia, and the development of adventitious growth lines and rugae, may be interpreted as evidences of phylogerontism. Such evidences are present also in *Chonetes baragwanathi*. *Hipparionyx* is an offshore facies shell, but ponderous forms like *H. major* are not characteristic of that environment.

(3) *Hipparionyx* is widespread in Victoria, occurring in many localities in the Lilydale area, at Mooroolbark (Hull Road),

at Kilsyth (for locality see Chapman, 1907), at Killara (Syme's Homestead—for locality see Gill, 1945b), and now in Gippsland. It appears to be strictly limited to beds of offshore facies. This is true also of New Zealand, where it occurs in the Lower Devonian beds of Bohemian (offshore) facies on the Baton River, but is not recorded from the contemporaneous beds of Rhenish (inshore) facies near Reefton.

Genus CHONETES Fischer, 1837

Chonetes baragwanathi sp. nov.
Pl. III, Figs. 10, 14, 16, 20, 23.

Type Material. Holotype consisting of the steinkern of a ventral valve on specimen 27,219 from locality G 23. *Paratype* consisting of the steinkern (specimen 27,214B) and an external mould (27,214A) of a dorsal valve from locality G 23.

Description of Holotype. Ventral valve sub-semicircular, strongly convex but also crushed a little anterior-posteriorly, thus shortening its natural length and exaggerating its natural convexity. Greatest width of shell 3 cm., greatest length (measured in one plane) 1·2 cm., and length following profile 2·1 cm. Shallow median fold as in *Chonetes robusta.* Hingeline straight and slightly less than greatest width of shell. Interarea smooth, narrow—about 0·5 mm. Along the cardinal margin are the stumps of strong spines set at right angles to the hingeline. There are indubitably three on each side of the umbo, and their positions suggest that there were five on each side. Beak inconspicuous. Thin and relatively high median septum extending to a point 3·5 mm. from the umbo, after which there is a continuation in the form of a very slight rise on the floor of the shell as far as 6 mm. from the umbo. The septum is merged with the palintrope posteriorly and ends abruptly anteriorly except for the linear incipient septum already mentioned. During cleaning, the steinkern broke away a little on the right side of the septum, but there is still clearly shown on the other side a small narrow platform, i.e., an excavation in the original shell, widening anteriorly and merging into the general floor of the shell where the main septum ends. Outside this platform on each side is a marked depression in the steinkern (raised portion in the original shell), outside of which again is a corresponding raised portion (depression in shell).

These structures are minute, occurring within 3 mm. radius of the umbo; they are interpreted as organs belonging to the muscular system.

When counted in the middle of the shell, there are 32 slightly sinuous costellae, some of which bifurcate so that they number 42 on the anterior margin. The costellae are moderately sharp in cross-section where well preserved, and each intercostellar space is approximately equal in width to the adjoining costella. The interior of the shell is closely and finely papillose, but the papillae tend to be limited to the intercostellar spaces of the steinkern (i.e., the inside surface of the costellae of the external surface), the possible significance of which has been discussed elsewhere (Gill, 1949a). The papillae are elongate and orientated to the direction of the costellae; they are generally less than 0·25 mm. long. Very fine growth lines appear on the holotype steinkern and have been noted on other steinkerns and external moulds (e.g., specimens 27,180 and 27,183, which are counterparts), so much so that they are regarded as characteristic of this species.

On specimen 27,200 is to be seen part of each of the two valves of this species *in situ*. The dorsal valve is strongly concave, and the space between the two valves small, as it is in *Chonetes robusta* (vide Chapman 1903, Pl. XII, Fig. 8).

Description of Paratype. Shell strongly concave, and of outline and ornament similar to those of the holotype ventral valve. From the small part of the hingeline preserved on the steinkern, it is inferred that the dorsal interarea was linear. On the interior, at the umbo, are two sub-rectangular plates or low flattened nodes between which (on the midline) there is a furrow shown by a raised platform on the steinkern. From the lower outer edges of the plates project fine plate-like septa 2-2·5 mm. long. Between the plates is a muscle area characterized by absence of costellae, due no doubt to secondary calcification. A median septum is present, about 6·5 mm. long, which is low and somewhat indistinct in the muscle field, but high and plate-like anterior to the field. The same long median septum and accessory septa are seen in specimen 27,183 from locality G 22. This is the steinkern of a dorsal valve, the external mould of which is seen on its counterpart, specimen 27,180 associated with *Eospirifer eastoni* sp. nov. (Pl. III, Figs. 20, 23).

Comment. Chonetes baragwanathi is closely related to *C. robusta* of the Upper Yeringian (Chapman 1903, Gill 1942, 1945a, 1949a, 1949b). It possesses similar general proportions and variations in proportions, similar convexity, similar small body space

between the valves, similar costellation, and similar short ventral median septum. On the other hand, the new species contrasts with *C. robusta* in—

(1) The presence of growth lines and papillae. Neither of these structures is seen in the holotype, which is re-figured in Pl. III, Fig. 17, nor have they been seen by the writer in any other specimen belonging to the species.

(2) The small structures on each side of the ventral median septum are quite different from those in *C. robusta.* The holotype of the latter does not preserve this area of the valve, and so there is figured herewith (Pl. III, Fig. 15) a specimen of *C. robusta* glued to the same plaque as the holotype by the author of the species as being a further typical example of the form; it is also a topotype.

(3) The costellae in *C. baragwanathi* occupy more space than those in *C. robusta.* The former is much bigger than the latter, but the two have approximately the same number of ribs.

(4) The holotype of *C. robusta* is larger than is usual for that species, and indeed I have seen none larger. But *C. baragwanathi* is half as big again as the holotype of *C. robusta,* and the other specimens present in the Sandy's Creek collection show that the holotype of the new species is a typical specimen.

(5) Of considerable interest and importance are the plates and long median septum in the interior of the dorsal valve. The umbonal plates are interpreted as crural bases because they occupy the position usual to those structures and could well fulfil their function. However, they are not as divergent as the crural bases usually are in *Chonetes.*

C. baragwanathi is the most advanced of the *C. robusta* group of species, viz., *C. robusta, C. killarensis, C. productoida,* and *Chonetes* sp. from Jerusalem Creek (Gill 1945c, p. 123).

Genus TANCREDIOPSIS Beushausen

Tancrediopsis raricostae (Chapman)

Pl. II, Fig. 4; Pl. III, Figs. 5, 8, 11.

Palaeoneilo raricostae Chapman 1908, Mem. Nat. Mus., Vic., No. 2, pp. 34-35, Pl. III, Fig. 50.

Material for Description. A single specimen (No. 27,229A) from locality G 24. It is a steinkern of a right valve, and a small piece of the external mould (No. 27,229B, now mounted in plaster of paris) was obtained when clearing the fossil; this shows the nature of the ornamentation.

Description. Length 2 cm., height 8 mm., and thickness (of single valve) 3 mm. Shell rostrate, the umbo being half way between the anterior and posterior ends of the valve. Shell convex, especially in the umbonal region, but somewhat depressed towards the outer margins. Anteriorly broad and well rounded; the margin meets the cardinal line at an angle of the order of 160°. Posteriorly the height of the shell is much reduced. There is a shallow but definite depression down the umbonal slope. At the posterior end of the shell, near the cardinal margin, is a subcircular scar about 3 mm. in diameter. Cardinal line arcuate; dentition taxodont, teeth large. The beak is depressed so as to hide the central part of the cardinal line, but nine teeth can be counted on the anterior side of the umbo and ten on the posterior side (although the innermost one is small). The steinkern shows that the sockets are quadrate on the anterior side of the umbo, but on the posterior side they are more elongate and possess a median ridge (furrow in the steinkern).

As shown by the space between the steinkern and external mould, the shell was 0·5 mm. thick at the umbo. The fragment of external mould shows the ornament to consist of well-marked lamellae nearly a millimetre apart; the areas between the lamellae have numerous fine striae parallel with the lamellae.

Comment. The holotype specimen of this species (National Museum reg. no. 7,918) had only about one-eighth of an inch of the hingeline showing, the original figure being in the nature of a reconstruction to a certain extent. The steinkern has now been cleared and is re-figured (Pl. III, Fig. 11), but the hingeline characters are poorly preserved. The Sandy's Creek fossil is not considered to vary specifically from this type.

McLearn (1924, p. 100) referred Chapman's species to the genus *Tancrediopsis.*

Genus COSMOGONIOPHORA McLearn, 1918

Cosmogoniophora sp.

Part of a valve is preserved on specimen 27,226 from locality G 24. McLearn established the genus to include *Goniophora* species possessing radiating striae. *Cosmogoniophora* was noted to be very common in the Devonian, but in the Silurian confined to the Arisaig Stonehouse Formation. Shells with ornament similar to the one from Sandy's Creek occur at Hull Road, Mooroolbark.

Genus LOXONEMA Phillips, 1841

Loxonema australis (Chapman)

Pl. II, Fig. 5.

Loxonema sinuosa Sowerby, var. *australis* Chapman 1916, p. 96, Pl. V, Fig. 39.

Chapman's new variety was based on a fragment of a shell from Cave Hill, Lilydale, consisting of most of one whorl and a little of the one above it. For reasons set out below the variety is raised to species status.

Re-description of Holotype. This is National Museum reg. no. 12,851. The whorl profile is rounded, and the sutures moderately deep. The whorl is about 2 cm. in diameter and the part visible in the complete shell about 1 cm. high. The ornamentation is costellate, the costellae being of rounded cross-section, and the interspaces the width of a costella or less. There are eight to nine costellae per cm. The costellae begin at the upper suture at almost a right angle to the suture, then curve round so as to make an angle of about 50° with the lower suture. One small area of steinkern shows that the interior was smooth.

Comment on Holotype. It is very difficult to make out the "tendency to form a faint nodose shelf near the basal part of the whorl" on which Chapman based his variety. However, the form contrasts with *L. sinuosa* in that the ornament is much coarser, and the costellae follow a much straighter course. In *L. sinuosa* the costellae are sigmoid, but this term can scarcely apply to the form from Lilydale. In view of these marked differences, I suggest the variety be established as a species.

Description of Sandy's Creek Form. Specimen 27,217 from locality G 23 is a steinkern of the two lower whorls, above which appears the external mould of five further whorls, but the nucleus is missing. The steinkern of the lowest whorl is not quite complete, but the one above it is 1 cm. in diameter. The whorls decrease evenly in size, and the highest is 2 mm. in diameter. The whorl profile is rounded and the sutures moderately deep. The ornamentation is costellate, and the course of the costellae across the face of the whorl is as described for *L. australis*. The steinkern shows that the interior was smooth, except that the ornamentation shows faintly on part of the lowest whorl.

Comment on Sandy's Creek Form. The only difference I can see between the type of *L. australis* and the form just described is that the form is larger and the ornamentation proportionately coarser. As the whorls get bigger, the costellae become fewer per cm. of whorl face. On present knowledge it would appear that the

Sandy's Creek form belongs to *L. australis*. The holotype is rather an inadequate specimen, but better topotype material has not yet been found to enable a fuller description of the species.

In the National Museum collection (reg. no. 1569) there is a similar form of *Loxonema* from "Griffith's Kiln, 7 miles south of Mansfield," i.e., Loyola. The specimen was presented by Mr. E. O. Thiele. The Loyola locality is also a Yeringian one (Lower Devonian). The North American forms *L. hamiltoniae* Hall and *L. delphicola* Hall, both of Hamilton age, are of similar type to *L. australis*.

?*Ceratiocarid telson*

Pl. III, Fig. 13.

On specimen 27,226 from locality G 24 is a fossil of uncertain affinities. It may well be the telson of a large ceratiocarid. Its length is 8·8 cm. and its width 6·5 mm. at one end and 1·5 mm. at the other. The fossil is a smooth steinkern, not quite complete. The line down the length of the spine is a fracture such as would be expected with the crushing of a hollow structure of this shape. The flattening exaggerates the natural width at the wide end. The fossil appears to have been originally of oval cross-section, and in this it differs from any eurypterid spine I have seen. The broken wide end suggests a broken-off spine. However, the possibility of the fossil being a particularly large *Coleolus* type of shell, for instance, cannot be dismissed, but no sign of the ornamentation common with such forms is in evidence. Shells of the *Coleolus* type are common in Lower Devonian beds in Victoria, but are always comparatively small.

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DESCRIPTION OF PLATES

Plate II

Fig. 1. *Hipparionyx major* sp. nov. External mould of HOLOTYPE.

Fig. 2. *Hipparionyx major* sp. nov. Steinkern of PARATYPE. The posterior margin has been partly inked in to assist recognition of structures.

Fig. 3. *Hipparionyx major* sp. nov. Steinkern of HOLOTYPE dorsal valve.

Fig. 4. *Tancrediopsis raricostae* (Chapman). Steinkern ×2 to show hingeline features. HYPOTYPE.

Fig. 5. *Loxonema australis* (Chapman), showing part of steinkern and part of external mould. HYPOTYPE.

Fig. 6. *Protoleptostrophia affinalata* sp. nov. Posterior margin of HOLOTYPE steinkern enlarged to show hingeline features. ×2.

Fig. 7. *Conchidium polymitum* sp. nov. Part of steinkern of HOLOTYPE enlarged to show character of interior plates of ventral valve. ×2.

Fig. 8. *Hipparionyx major* sp. nov. Steinkern of HOLOTYPE photographed to show especially the ventral valve interior.

Note. Figures are natural size except 4-7, which are enlarged to twice natural size in order to show certain structures more clearly.

Plate III

Fig. 1. *Cariniferella alpha* sp. nov. HOLOTYPE steinkern, ventral valve.

Fig. 2. *Cariniferella beta* sp. nov. External mould of ventral valve preserved on specimen 27,202. HOLOTYPE.

Fig. 3. *Cariniferella beta* sp. nov. HOLOTYPE steinkern, ventral valve.

Fig. 4. *Cariniferella beta* sp. nov. External mould of ventral valve preserved on specimen 27,182. HYPOTYPE.

Fig. 5. *Tancrediopsis raricostae* (Chapman). Fragment of external mould of Sandy's Creek specimen. HYPOTYPE. ×2.

Fig. 6. *Cariniferella alpha* sp. nov. External mould of dorsal valve preserved on specimen 27,182. HYPOTYPE.

Fig. 7. *Cariniferella alpha* sp. nov. PARATYPE steinkern of dorsal valve.

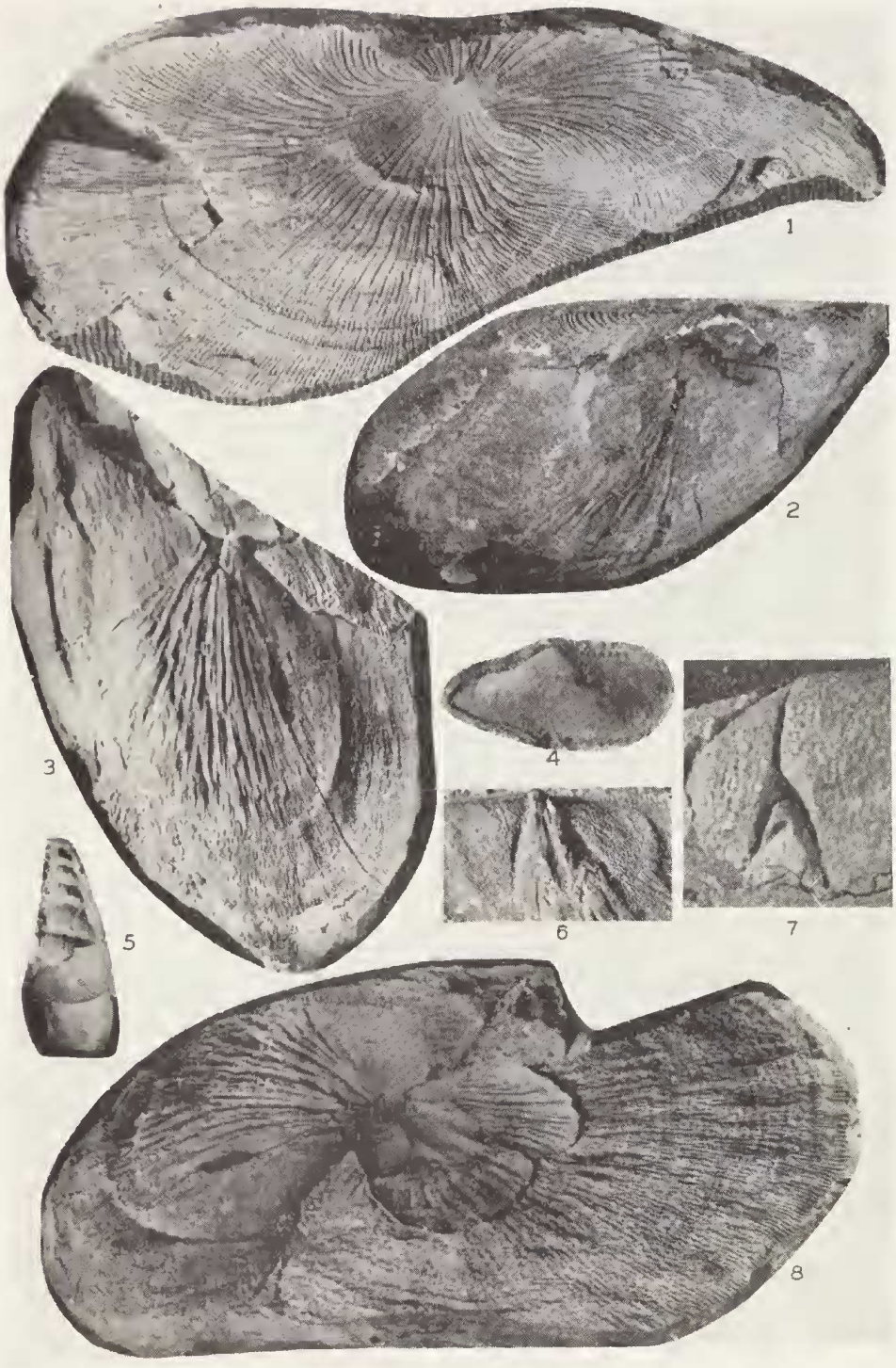
Fig. 8. *Tancrediopsis raricostae* (Chapman). Specimen from Sandy's Creek. HYPOTYPE.

Fig. 9. *Cariniferella beta* sp. nov. PARATYPE steinkern of dorsal valve. Beside it is a specimen of *Conchidium polymitum* sp. nov. to show the nature of the ornament (HYPOTYPE).

Fig. 10. *Chonetes baragwanathi* sp. nov. PARATYPE steinkern of dorsal valve showing internal structures.

Fig. 11. *Tancrediopsis rarieostae* (Chapman). HOLOTYPE. The hingeline was cleared before this photograph was taken.

Fig. 12. *Conchidium polymitum* sp. nov. HOLOTYPE steinkern.



Victorian Devonian Fossils.